SDI AND THE WINDS OF CHANGE

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SDI: Vision and Reality

For those of us who were working in the field of strategic defense, the uplifting effect of President Reagan's dramatic announcement of SDI, almost ten years ago, was mixed with a tinge of consternation. It was exciting that strategic defense was finally being pulled from the backwaters of defense programs and elevated to a position of national prominence. At the same time, the lofty rhetoric surrounding the announcement sounded as though we were on the threshold of achieving major breakthroughs in the means of achieving effective defense. Few, if any, of us knew what those means were. The inspiration of the President's challenge was moderated by the sobering question of how it was to be accomplished.

There have been few times in history when a major development program was launched by a "call to arms" by the President of the United States. President Kennedy's call in 1961 for landing a man on the moon by the end of the decade was one such precedent, but it was different in a number of respects. The technological means of reaching President Kennedy's goal were suffused throughout the scientific community and the challenge was to harness those means for this bold new mission. There was more support than surprise, more consensus than concern.

In the wake of the SDI announcement, the goal was interpreted to mean that a near-perfect defense would be devised against a Soviet attack of thousands of missiles. It was well known that multiple tiers of defense could, in principle, repel a ballistic missile attack with a high degree of effectiveness. The problem was that large numbers of attackers required an incredibly complex and costly defense deployment. The technology requirements for a defense of this complexity and scale were formidable in all respects, but one key technology need stood out: space-based directed energy weapons (DEWs). The technical consensus was that DEWs were required to thin a massive missile attack in the boost-phase, before the missiles off-loaded their payloads, but the embryonic state of development of DEWs would not support a defense deployment for the foreseeable future.

Hence, the implementation of the President's SDI vision presented a technology barrier and an economic issue: a DEW breakthrough that was not confidently predictable and, if technical success was achieved, a defense deployment of such immense complexity and scale that it's economic feasibility was uncertain.

It has been widely reported that President Reagan was advised that DEWs, and specifically the X-ray laser, were nearer to perfection than later research proved to be the case. Whether or not this is true, the SDI program grappled with the daunting objective of virtually impenetrable defense for several years without getting perceptibly

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closer to the large jumps in technology that would make it technically feasible.

Bowing to Reality - In the Wrong Direction

In the face of relatively unyielding technology, the SDI program was changed in 1987 to take on a modest intermediate goal, requiring a less complex system response. The appearance of backing down from the original goals of the program had been strenuously resisted and when it occurred, it was denied that it was a change. The problem was that the 1987 change, which can be characterized as the start of the Phase I architecture period ("architecture" was the term invoked for "system"), introduced serious questions about the validity of the mission requirements and the selection of the architecture design.

When the credibility of the Soviet missile threat disappeared, the program was changed in 1990, again with a denial that it was a change, to the concept of Global Protection Against Limited Strikes (GPALS). GPALS adopted a more realistic missile threat, but it retained a questionable emphasis on space-based weapons and asserted a global defense mission which has no international sanction.

The Need to Match Objectives and Means

There is a critical need to define the SDI program to match objectives and means, without carrying over the baggage of weapons that no longer fit the needs or concepts that are grander in scale than makes sense in the current world order.

It order to establish SDI objectives that are consistent with the means of carrying them out, it is essential that the critical aspects of both objectives and means be examined as an integrated whole. The lessons of the past are clear that piecemeal or disjointed consideration of critical aspects have led to illogical and indefensible program constructions. Objectives must be framed in terms of the threat and the mission and means must be simultaneously considered in terms of system and technology.

The meaning of the four aspects of SDI cited above are as follows:

<u>Objectives</u>:

- Threat: What is the source, size and characteristics of the ballistic missile force to be defended against?
- Mission: What value structure (class of targets) is to be defended and what is the level of effectiveness is to be achieved?

<u>Means</u>:

- System: What kind of system is proposed to meet the threat and satisfy the mission objectives, in terms of operating regime (boost-phase, midcourse, terminal) and composition?
- Technology: What is the degree of maturity of the technology represented in

the system?

It is instructive to analyze the history of SDI using the criteria outlined above. A diagnosis of the three main phases of SDI since 1983 provides the basis for a prescription for change.

The Research Phase, 1983-1987.

There was no explicit correlation of objectives and means during the research phase. As William Broad observed in his book *Teller's War,* " The Federal program of antimissile research that grew out of President Reagan's initiative had no real focus. It was basically a scientific free-for-all, a license to spend tens of billions of dollars as creatively as possible." As previously noted, much of this free-for-all swirled around a search for the key to near-perfect defense, revolutionary space-based directed energy weapons that could destroy missile boosters with the speed of light, shortly after they lumbered out of their protective silos.

It is reasonable to infer that the research phase envisioned the threat of a massive, preemptive missile strike by the Soviet Union and a mission of defending against such a threat with near perfection. From the findings of the Defense Technology Study Team (DTST or Fletcher Panel), derived in 1984, it can be further inferred that the resulting defense system would entail 3-4 tiers of defense featuring DEWs and "birth to death tracking" of the threat. It was recognized in the DTST that the battle management, communication, command and control (BM/C^3) network required to effectively integrate and control such a system would be a major challenge (technical critics would subsequently allege that this aspect of the system bordered on the impossible). Significantly, the DTST concluded that the X-ray laser concept, reportedly the trigger for the SDI announcement, would be relatively ineffective in a defense system, even if it could be perfected.

An implicit assumption underlying the first phase of the SDI program was that a technical breakthrough was imminent. It was anticipated that the technical breakthrough would simultaneously solve the riddle of feasibility and usher in the opportunity for a change in strategic doctrine from Mutual Assured Destruction to Assured Survival. In President Reagan's words, the doctrinal change wold mean that we could "save lives rather than avenge them." The form of the technical breakthrough was DEW. The X-ray laser DEW concept (code name, Excalibur), invented at the Lawrence Livermore National Laboratories, remained a high priority part of the research program, despite the questions raised by the DTST. However, a host of other DEW concepts were pursued in parallel.

DEW concepts and technology did not suddenly burst upon the scene on the eve of the inauguration of SDI in 1983. A number of DEW concepts had been under investigation for several prior years in the Army BMD program, including chemical

lasers, free electron lasers and neutral particle beams. The main difference was that the funding for DEW programs was substantially increased under the SDI program. Accompanying the increased funding was a tidal wave of enthusiasm and extravagant claims about the capability and near term availability of DEWs.

A corollary to the increased investment in DEWs during the research phase was a significant diminution in interest in more traditional forms of ballistic missile defense (BMD). This is not to say that funding was not allocated to more traditional, ground-based elements. In fact, unprecedented funding levels were initially applied to several ground-based elements, such as the Exoatmospheric Reentry Intercept System (ERIS). However, larger funding allocations, higher program priorities and far more high level attention within the Reagan administration (and later the Bush administration) was paid to DEWs. There was a radical shift in emphasis from the predecessor Army BMD program pattern of incremental development, based on mature ground-based systems and technology, to quantum leap objectives, based on the vision of rapid weaponization of DEWs for deployment in space.

One of the reasons for SDI program tolerance of more traditional ground-based elements during the research phase was the success of the Army's Homing Overlay Experiment (HOE) in June, 1984. This experiment marked the first time that nonnuclear kill of an ICBM warhead was demonstrated in an actual flight test. The experiment gained international attention, including acknowledgment by the Soviet Union, and the SDI Office jumped at the opportunity to garner credit for the SDI program (it did not matter that work on the experiment was begun by the Army six years before SDI was created). The HOE test was the most significant event to occur in the research phase of SDI, producing the only hard evidence that the pervasive SDI objective of nonnuclear kill could be achieved.

The successful HOE experiment had far-reaching significance to the efficacy of ground-based defense concepts. It dispelled the stereotype of "primitive" Army systems of the past, epitomized by the SAFEGUARD system, that were constrained to minuscule footprints (defended coverage) per defense unit and saddled with the onerous requirement of nuclear warheads on the defensive interceptors. With HOE technology, adopted by the next-generation ERIS interceptor (now called Ground Based Interceptor, GBI), ground based systems were emancipated from the limitations of radar horizons and infused with guidance accuracy that made nonnuclear kill a reality. This legitimate breakthrough was, and continues to be, obscured by the widespread official infatuation with exotic, space-based weapons.

The anticipated breakthrough in DEWs that fueled the early fervor for a quantum leap in strategic defense capability never came. The X-ray laser research, the touchstone of early-SDI, sank into a morass of disputed experimental results and finger-pointing blame for premature claims within Livermore labs. Once a topic of such import that it was periodically discussed in White House meetings, the X-ray laser phenomenon

slowly decayed from the preeminent promise for SDI success to an obscure, if not now abandoned, laboratory curiosity. Other DEW weapon objectives also failed to yield to massive injections of funding.

The Phase I Architecture Phase - 1987-1990.

In this phase there was a clear definition of objectives and means, but the two were not in balance. The means far outweighed the objectives.

A mission objective for the Phase I architecture was defined by the Joint Chiefs of Staff that required an effectiveness level of less than 50% (less than one-half of the warheads in a first wave Soviet attack were required to be killed by the defense). The value structure to be defended was not specified. The system (architecture) defined to meet the Phase I requirements was composed of boost-phase and midcourse elements and the technologies were relatively mature. The boost-phase element of Phase I featured the use of kinetic energy weapons (KEW), rather than DEWs. The modest effectiveness level required of the Phase I architecture, coupled with the absence of definition of value structure to be defended, created fundamental questions about the purpose of Phase I. Was Phase I intended to defend military targets or cites, to enhance deterrence or replace it?

The relaxed requirement for Phase I led some observers to conclude that preferential defense of military targets must be the defense mission; however, this mission objective was denied by high level defense officials. It was asserted that the mission was to kill attacking warheads, regardless of where they were aimed (a position that was probably taken to avoid the appearance of compromising the lofty objectives for SDI originally enunciated by President Reagan). If, however, the attacking warheads were aimed at cities, the system was demonstrably too porous to limit damage to a significant degree. The dilemma thus created was that the capability of the system to preferentially defend military targets was concealed and the limitations of the system in defending cities was exposed.

The apparent reason for the definition of the Phase I architecture was to answer congressional criticism that there was nothing to show for the mounting investment in SDI. By defining a system that could be deployed early, it was anticipated that such criticism would subside. This was not to be.

The space based weapons used in Phase I attracted intense criticism in the U.S. Senate when the architecture was unveiled and that criticism has persisted to the present. The arguments presented against the proposed early development and deployment of space-based KEW weapons included the view that it would be strategically destabilizing to follow this course, and the ABM Treaty would be threatened even by development and testing of space weapons; the weapons were a reincarnation of the old BAMBI concept, considered and dropped years before in

ARPA; the cost would be excessive; and they would be vulnerable to the countermeasures of anti-satellite weapons and fast burn boosters.

A potentially more devastating criticism of the space weapons used in Phase I, known only to analysts inside the defense establishment, was that they were not needed to meet stated effectiveness requirements. An all ground-based architecture, using only ground-based ERIS and High Endoatmospheric Defense Interceptors (HEDI) interceptors was more cost-effective. Aside from the institutional bias in favor of space-based weapons inside the administration, a probable response to this criticism was that continued growth of the Soviet missile threat would justify the use of space weapons. The fact that such growth was subsequently curtailed by START agreements and the dissolution of the Soviet Union has undercut this counterargument for deployment of space weapons.

The undeniable problem faced by the administration in pushing for early deployment of space weapons was that their use made a great deal more sense during the research phase, when the threat was enormous, than for the reduced Phase I threat. The real payoff for space weapons, functioning in the role of killing boosters rather than individual warheads, was against very large threat sizes. In this role, the leverage of killing all of the warheads of a multiple warhead missile with one shot is sufficient to justify the cost of deploying space weapons.

The Global Protection Against Limited Strikes (GPALS) Phase - 1990-Present.

The most positive aspect of the GPALS phase is that it gave belated recognition to the fact that the threat of a large scale Soviet attack was no longer credible. The threat was changed to one of an accidental or unauthorized Soviet attack and the threat of a third world missile attack. The national missile defense (NMD) mission was also tightened up to require a high level of effectiveness against the more limited threats, a major improvement over the almost trivial mission of the Phase I architecture.

The fatal flaw in the GPALS concept is that it took on the mission of defending all nations of the world against missile attacks from any other nation, using space-based weapons as the primary means of enforcing the mission.

In addition to the NMD part of GPALS the program contains Theater Missile Defense (TMD) and Global Missile Defense (GMD) parts. A multiplicity of defense concepts have been defined for the three different parts of GPALS, but the ultimate global mission is composed principally of a space-based tier overlaid on ground-based tiers for both national and theater defense. The space-based tier retained the use of KEWs, but the design was changed from the multiple kill vehicles per satellite platform used in Phase I to single, relatively autonomous kill vehicles (Brilliant Pebbles).

The problem is that most of the missiles in the third world threat are short range

missiles, against which Brilliant Pebbles has a marginal capability, and the accidental and unauthorized parts of the threat are too small to justify the cost of deployment of Brilliant Pebbles. These limitations of Brilliant Pebbles were exposed in the SDI sponsored Architecture Integration Study (AIS), but they did not prevent program planning for inclusion of Brilliant Pebbles in the preferred architecture.

The most serious consequence of the continued emphasis on space weapons under GPALS are the strains induced between the U.S. Senate and the SDI program in relation to the National Missile Defense Act of 1991. This Act requires the development and deployment of a missile defense system that is "cost-effective, operationally effective and ABM Treaty compliant." Compliance with the terms of the ABM Treaty requires that the single authorized site be ground based. However, the continued priority ascribed to space element development within the SDI program has led to cancellation and cutbacks of key ground-based elements required for an effective single site defense. Moreover, one of the cancelled ground-based elements, the Ground Based Surveillance and Tracking System (GSTS) has been replaced by upgraded early warning radars, which may be in violation of the ABM Treaty.

In hearings by the Senate Armed Services Committee on the FY93 SDI budget, Senator Nunn questioned the priorities of the SDI program which resulted in failure to comply with the requirements of the National Missile Defense Act. In particular, he expressed strong reservations about the cancellation of GSTS. This decision deprived the single authorized site of the capability to protect the entire Continental United States, a self-induced limitation that Senator Nunn viewed as sufficiently serious to raise questions about the justification for proceeding with implementation of the Act.

It is noteworthy that two different acts of the Congress currently require the SDI program to support priority development of ground based defense elements. It is also significant that the House Armed Services Committee has zeroed the budget for Brilliant Pebbles for two consecutive years and the joint conferences for the authorization bills have subsequently inflicted deep cuts in the Brilliant Pebbles budget.

The Common Thread: Space-based Weapons.

The three phases of the SDI program sketched above have seen significant changes is threat, mission, systems and technology, but one thing has remained constant: a dedication to space-based weapons as the centerpiece of the program. A compelling rationale for the use of such weapons existed only in the first phase, the research phase. In this phase, the threat was so large that space-based weapons were required to thin the attack in the boost-phase. The rationale has become weaker in each of the next two phases and there is now no reason to continue the priority development of space weapons.

A New Plan for Strategic Defense

Concept:

The name SDI should be changed to Missile Defense Program (MDP). The new program should consist of the following three parts:

- National Missile Defense (NMD).
- Theater Missile Defense (TMD)
- Missile Defense Technology (MDT)

The main building blocks of the Missile Defense Program will be ground-based elements that match the objectives of NMD and TMD. The global defense mission of GPALS will be abandoned and Brilliant Pebbles will be phased out. DEW and other advanced technology will be carried out under MDT. A multi-year budget for the program will be developed that eliminates the unrealistically high levels currently planned and adjusts to a relatively flat budget profile. Preliminary assessments reveal that the objectives of NMD and TMD can be met, including deployment of a Treaty-compliant defense system, if the large investment in space elements is cut back, marginal experimental programs are cancelled and program overhead is reduced. This can be done while maintaining a vigorous technology program.

National Missile Defense NMD :

The threats of accidental, unauthorized and third world attacks should be retained as the NMD threat, and the current effectiveness objectives should remain. NMD should be planned in two phases, an initial, ABM Treaty-compliant deployment phase and an option for a multi-site ground-based deployment phase.

The following elements are essential to meet the requirements of the National Missile Defense Act and to provide options for growth:

- Ground Based Interceptor (GBI)
- Endoatmospheric/Exoatmospheric Interceptor (E^2I)
- Ground Based Radar (GBR)
- Ground Based Surveillance and Tracking System (GSTS)
- Battle Management/Communication Command and Control (BM/C^3)

The ground based interceptor (GBI) is a long range, exoatmospheric interceptor, capable of providing protection of the entire Continental United States from a single site. Unlike the interceptors used in the SAFEGUARD era, GBI is capable of killing attacking warheads without the use of a nuclear warhead. The capability of GBI has been demonstrated in flight tests where intercontinental range warheads have been successfully killed by nonnuclear intercepts. It is planned to be deployed in the single

site authorized under the National Missile Defense Act.

The E^2I interceptor has been cancelled by SDIO, but it represents a class of ground-based interceptor that needs to be revived as an element of the program and an option for a highly effective defense architecture. Conceptually, E^2I could operate both above the atmosphere and within the atmosphere, thus providing operational flexibility and deep battlespace. E^2I was a victim of conflicting priorities within the SDI program. It is feasible to reinstate a redesigned version of E^2I, emphasizing the endoatmospheric region of operation, that would constitute an effective complement to GBI in a two-tier defense architecture.

The Ground Based Radar (GBR) is a newly designed radar with levels of sensitivity and resolution that surpass the capabilities of any existing radars. It is planned that one GBR will be deployed under the National Missile Defense Act. The GBR is capable of performing the critical function of discrimination (differentiation between real and false targets) a function that is essential to achieve cost-effective performance against ballistic missile threats.

The Ground Based Surveillance and Tracking System (GSTS) is a rocket launched optical sensor which, as noted above, has been cancelled by SDIO. GSTS provides long range detection and tracking of ballistic warheads, unlimited by the radar horizon limit of the GBR, an essential cabaility to permit long range flyout and coverage of the GBI. GSTS is an effective complement to GBR in performing discrimination, providing optical sensor data to augment the microwave data of the GBR. The technology of GSTS is rooted in a number of successful predecessor programs and it is in an advanced state of development. It merits reinstatement for deployment under the National Missile Defense Act and retention as a critical adjunct to advanced systems.

The BM/C^3 element is not as tangible as the other elements described above, but it is the nerve center of any defense system and the means for tieing all of the other elements together. Composed essentially of computer hardware and software, BM/C^3 executes the algorithms for critical defense functions, such as discrimination, and relays commands to other elements and outside command centers. Contemporary commercial computer hardware and software technology provides a rich base for application to strategic defense problems. In addition, there is extensive strategic defense software available for adaptation to evolving defense needs. Frequently the pacing element in major defense development programs, BM/C^3 is a continuing area of research in the SDI program and the deployed site for the National Missile Defense Act will serve as a model and testbed for this critical element.

Another element that merits reevaluation and possible retention in the program at a reduced level of funding is Brilliant Eyes. Brilliant Eyes is a derivative of Brilliant Pebbles and it consist of a sensor on a space platform. It is designed to provide handover data on targets to both NMD and TMD systems to improve system

effectiveness. The current program plan is too highly accelerated and costly. It should be renamed Space Based Surveillance and Tracking System (SSTS), a more descriptive name that was previously used.

Theater Missile Defense (TMD):

The following principal elements of the TMD program should be continued:

- Patriot Upgrades
- Extended Range Interceptor (ERINT)
- Theater High Altitude Area Defense (THAAD)
- Corp SAM
- BM/C^3

The investigation of integrating ERINT with Patriot should be continued. The use of THAAD interceptors on Navy ships should continue to be an option and a topic of compatibility analysis.

Multiple Tiers of Defense:

The key NMD elements described above provide the basis for a two-tier ground-based architecture that is essential to the attainment of high levels of defense effectiveness in the future. Fundamentally, two independent tiers of defense yield defense leakage (the percentage of attacking warheads that penetrate the defense) that is the product of the leakage of each tier. Therefore, a leakage of 10% for each tier yields an overall system leakage of 1%. For the strategic threats of accidental, unauthorized and third world threats, characterized by small numbers of nuclear warheads, it is both desirable and feasible to evolve toward low leakage, two-tier defense.

The option of deploying two tiers for TMD should also be developed. The THAAD system with either Patriot, Patriot/ERINT or Corp SAM as an underlay are options that should be studied.

The Imperatives for SDI Change

In order for the SDI program to continue as a large scale defense program, it must preserve the fragile coalition of congressional support that currently exists. It cannot survive a continued adversarial relationship with the Congress, based on fundamentally divergent program objectives. Undoubtedly, a part of the SDI conflict that has marked the recent relationships between the Administration and the Congress has been based on partisan politics. However, as this paper has charged, the primary source of conflict has been the questionable emphasis on priority development and deployment of space weapons, pursued by both the Reagan and Bush administrations. If there ever was a solid justification for this emphasis, time and

events have overtaken it. It is imperative that the priorities of the program be changed, that the content of the program be realigned to conform to real world requirements and that the management of the program be changed.

The new program outlined above achieves the following urgent objectives: substantial reduction in funding for space based elements, reinstatement of critical ground-based elements that have been cancelled, increased funding for ground-based elements and technologies that are lagging because of past sub-threshold support, continued priority development of theater missile defense systems, elevation of priority for compliance with the requirements of the National Missile Defense Act, scrupulous compliance with the terms of the ABM Treaty and maintenance of a viable technology base.

With respect to the SDI organization, the two most glaring needs are to effect greater decentralization and to trim the size of SDIO. The SDI Office has managed the program in microscopic detail, in violation of fundamental management principles. Most of the program is farmed out to the services and other agencies, but these organizations have very little discretion in defining what needs to be done, in setting priorities or in the day-to-day execution of the program. As a result of excessive centralization, the SDI Office has become bloated and it has created an overhead cost that penalizes the substantive elements of the program. A significant part of this overhead cost goes to support contractors and studies that are marginally productive and in need of substantial reduction.